Executive Summary

This report documents an appraisal-level evaluation of raising Upper Klamath Lake in south-central Oregon. The lake is the State's largest freshwater lake and is a principal storage feature of the Klamath Project. The Klamath Project provides water for irrigating approximately 240,000 acres in the Klamath Basin in south-central Oregon and northern California. The Klamath Project was authorized for construction in 1905, and work began shortly thereafter. In 1921, Link River Dam was constructed at the south end of the lake, near the city of Klamath Falls, to provide regulation of the lake.

Background

The listing of fish species as threatened or endangered, and the Federal responsibility to protect Tribal trust assets, have placed increasing demands on the limited water supply of the Klamath Project and reduced its flexibility to meet demands. There is an immediate need to increase water supplies and improve the timing of their availability to improve fish and wildlife habitat and water quality.

The Bureau of Reclamation (Reclamation) began the Klamath Basin Water Supply Initiative (Initiative) in 1996 to identify options for increasing water supplies in the Klamath River Basin. The Initiative is a joint effort partnership of Reclamation, the Klamath River Compact Commission, the California Department of Water Resources, and the Oregon Water Resources Department. The Initiative identified 96 options for increasing water supplies and recommended 44 for further study, including raising Upper Klamath Lake.

Options Evaluated

The evaluation documented in this report considers increasing the maximum operating level of Upper Klamath Lake by 2 feet by raising Link River Dam. Two options are described: (1) raising existing levees around the lake to contain the lake within its current surface area and (2) allowing the lake to spread and flood adjacent lands.

Option 1 constrains the higher water surface elevation to the current shoreline. Modifications would be provided to protect all existing land, roads, and structures surrounding the lake.

A 2-foot-high parapet will be constructed on top of the dam to accommodate the higher water level. Major construction activities include:

- Eight sections of new seawall, totaling 6.6 linear miles
- Modifying 14 sections of existing dikes with roads, totaling 44.3 linear miles
- Modifying 10 sections of existing dikes without roads, totaling 25.2 linear miles
- Two sections of new dikes with roads, totaling 1.9 linear miles
- Three sections of new dikes without roads, totaling 2.7 linear miles
- Armoring two sections of existing dikes, totaling 3.5 linear miles
- Raising one bridge and county and local roads at seven locations, totaling 1.3 miles of roads
- Raising 2.5 miles of a State highway
- Rehabilitating 126 private residences (relocating septic tanks, providing foundation drainage, and landscaping)
- Rehabilitating headworks and intake structures at 10 locations
- Relocating an existing boat dock

The estimated cost of Option 1 is $125 million.

Option 2 does not protect structures and property, but, instead, allows the lake to spread beyond the current shoreline and flood adjacent lands. Existing dikes will be breached, and existing roads that would otherwise be inundated will be raised. Either existing headworks and water intakes at various locations will be retrofitted for the higher water surface elevation, or the associated facility will be purchased. Link River Dam will be modified as in Option 1. Major construction activities include:

- Breaching (every ¼ mile) 14 sections of existing dikes with roads, totaling 44.3 linear miles of dikes
- Breaching 10 sections of existing dikes without roads, totaling 25.3 linear miles of dikes
- Armoring 3.0 linear miles of an existing dike
- Raising one bridge and county and local roads at three locations, totaling 0.6 mile of roads

- Raising 2.5 miles of an existing State highway
- Rehabilitating headworks and intake structures at nine locations
- Relocating an existing boat dock

The estimated cost of Option 2 is $129 million, including $113 million for the acquisition of private land and structures.

Raising Upper Klamath Lake 2 feet will increase storage by approximately 170,000 acre-feet, or about 25 percent. Winter floodflows, which are presently spilled to the Klamath River and not available for project use, will be stored and made available to help meet water needs for endangered species, Tribal trust resources, agricultural contractors, and national wildlife refuges. Future operation of the enlarged lake will be contingent upon acquisition of appropriate rights to divert and store additional water in the lake and may require filing an application for the appropriation of additional water with the Oregon Water Resource Department.

Costs associated with implementing either Option 1 or Option 2 are significant. In addition, implementing either option will have both positive and negative impacts on the natural and human environment.

Recommendations

Several engineering studies are recommended. These include:

- Estimating quantities, properties, and availability of embankment and riprap materials, and identifying their locations (quaries)
- Constructing a modified dike test section to assess construction methodology and performance of rockfill protection
- Using detailed aerial topography (maximum 1-foot contours) of the Upper Klamath Lake shoreline to better define existing features and required improvements
- Conducting a comprehensive survey of all shoreline structures to provide a better estimate of the work required and associated costs
- Inspecting existing dam gates and concrete bulk heads to determine if additional modifications are required for the higher reservoir water surface

- Developing site-specific, cost-effective alternatives to the proposed shore protection features

- Identifying and securing suitable rights-of-way

Recreation facilities need to be analyzed in more detail to determine impacts and associated protection, relocation, and modification costs. A user survey and appropriate mapping of all recreational facilities has been initiated to determine existing recreation use levels and assist in the analysis of potential impacts.

A detailed hydrology study demonstrating that unappropriated water is available to fill the additional storage in Upper Klamath Lake is recommended. Better descriptions of area-elevation-capacity relationships and evaporation and transpiration losses will also be needed.

The following environmental studies are recommended:

- Develop detailed topographic information for the entire lake and surrounding area to predict the extent of flooding and potential vegetation changes

- Develop topographic mapping in 1-foot increments to predict effects on wetland vegetation

- Determine potential streamflow changes below Link River Dam and potential benefits to threatened and endangered fishes

- Determine impacts to upland areas that would be inundated by the higher reservoir water surface elevations.

The following economic studies are recommended:

- Determine all costs (e.g., planning, design, construction, mitigation, and operation, maintenance, and replacement)

- Determine benefit/cost

Early development and implementation of a public involvement plan will be essential to a feasibility study. Various studies to identify and analyze social impacts and impacts to environmental justice, Tribal trust, and cultural resources are recommended. Opportunities to avoid or lessen adverse impacts will also need to be identified.